(12) UK Patent Application (19) GB (11) 2 306 107 (13) A

(43) Date of A Publication 30.04.1997

(21) Application No 9521094.4

(22) Date of Filing 14.10.1995

(71) Applicant(s)
Stephen Griffiths
Ty Mawr Cottage, Waunfawr, Near CAERNARFON, Gwynedd, LL55 4BX, United Kingdom

David Leonard Scott
Ivydale, 3 Resthaven Road, WOOTTON, Northampton, United Kingdom

(72) Inventor(s)
Stephen Griffiths

(74) Agent and/or Address for Service
Geoffrey Owen & Company
76 Lower Bridge Street, CHESTER, CH1 1RU, United Kingdom

(51) INT CL^6
A62B 1/08

(52) UK CL (Edition O)
A5A A44
F2X X8C X8J

(56) Documents Cited

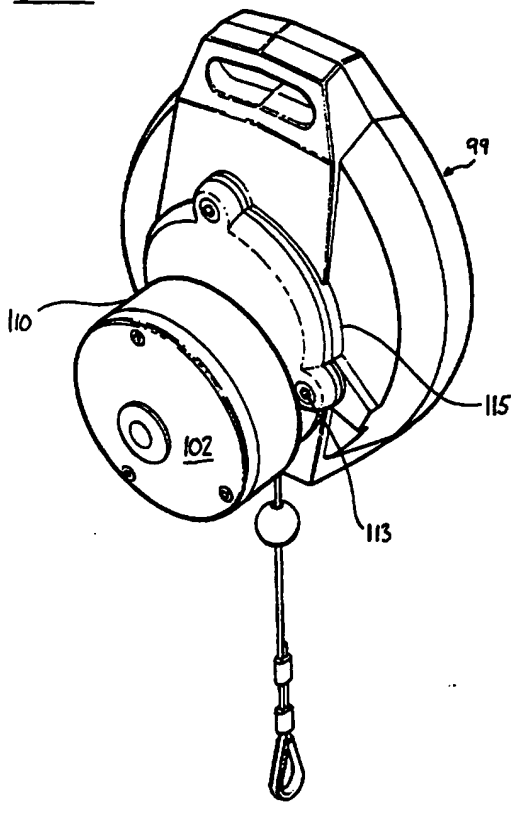
GB 2238720 A	GB 2057871 A	EP 0086279 A1
WO 94/03234 A1	US 5343976 A	US 4493396 A

(58) Field of Search
UK CL (Edition O) A5A , F2X
INT CL^6 A62B 1/06 1/08 1/14
Online: WPI, EDOC, JAPIO

(54) Safety device

(57) A safety device, of the type in which a lifeline is controlled to prevent injury of the user by falling, is formed as a modular system comprising a main assembly module 99 containing a pulley around which the lifeline is passed, and control modules 102 which can be attached to the main assembly module to control motion of the pulley. Two modules can be attached to the main assembly module, and these may arrest motion of the pulley, act as a winch, allow controlled motion of the pulley or perform other functions.

FIG.3



GB 2 306 107 A

FIG. 1

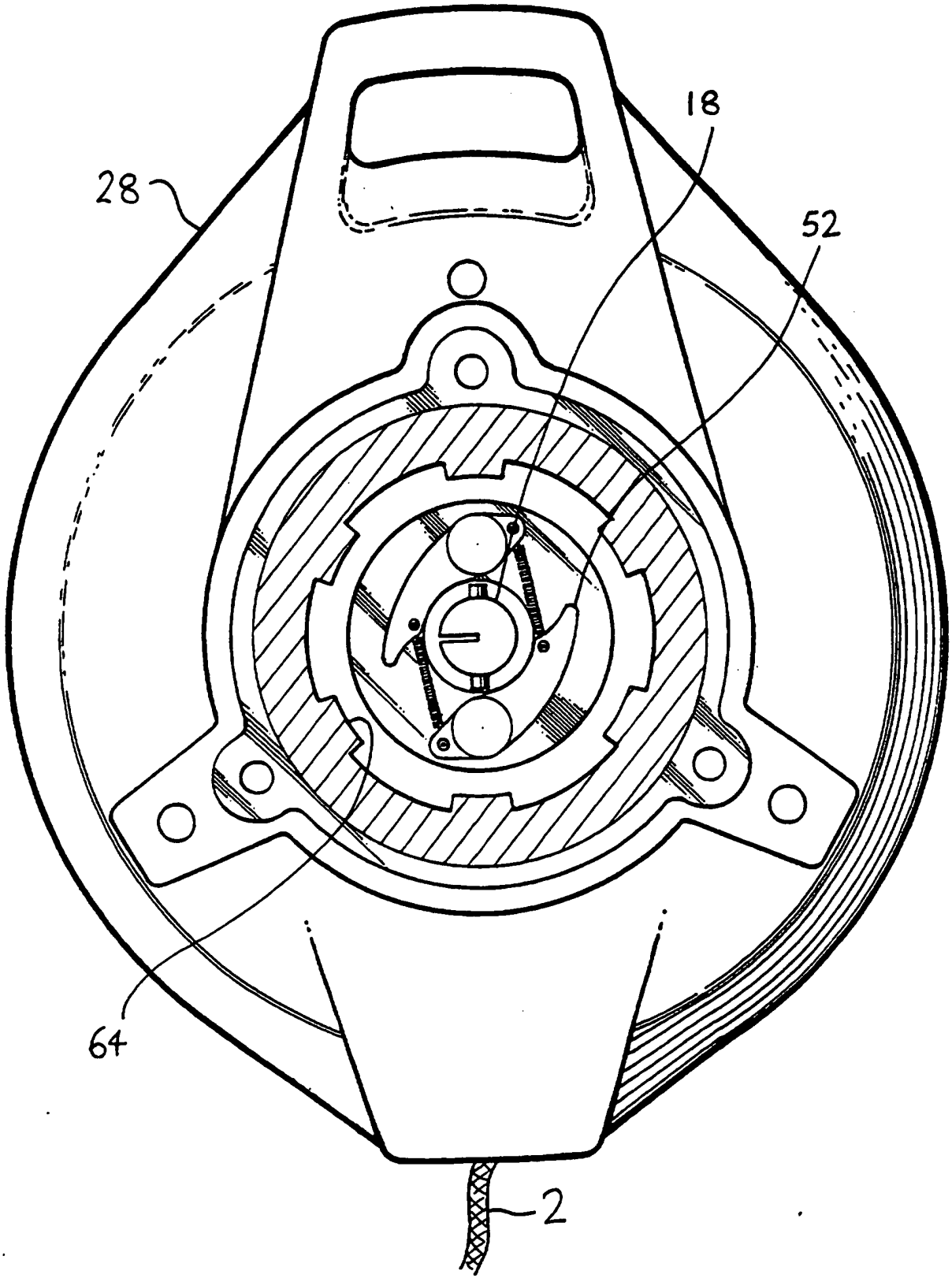


FIG.2

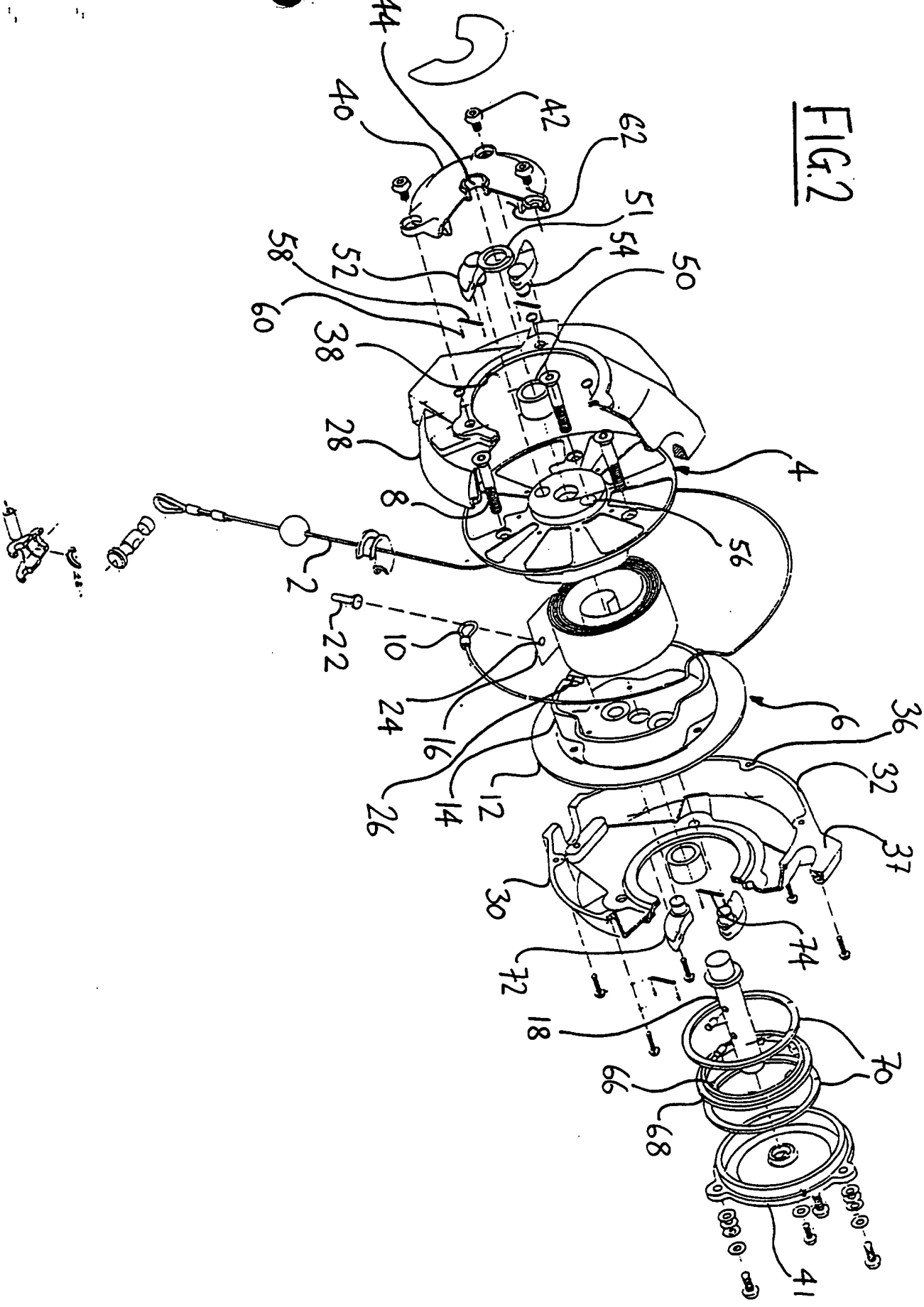

44
40
42
62
51
54
50
58
52
60
38
28
8
4
56
2
22
10
24
16
26
14
12
6
36
32
37
30
74
72
18
66
70
68
41

FIG.3

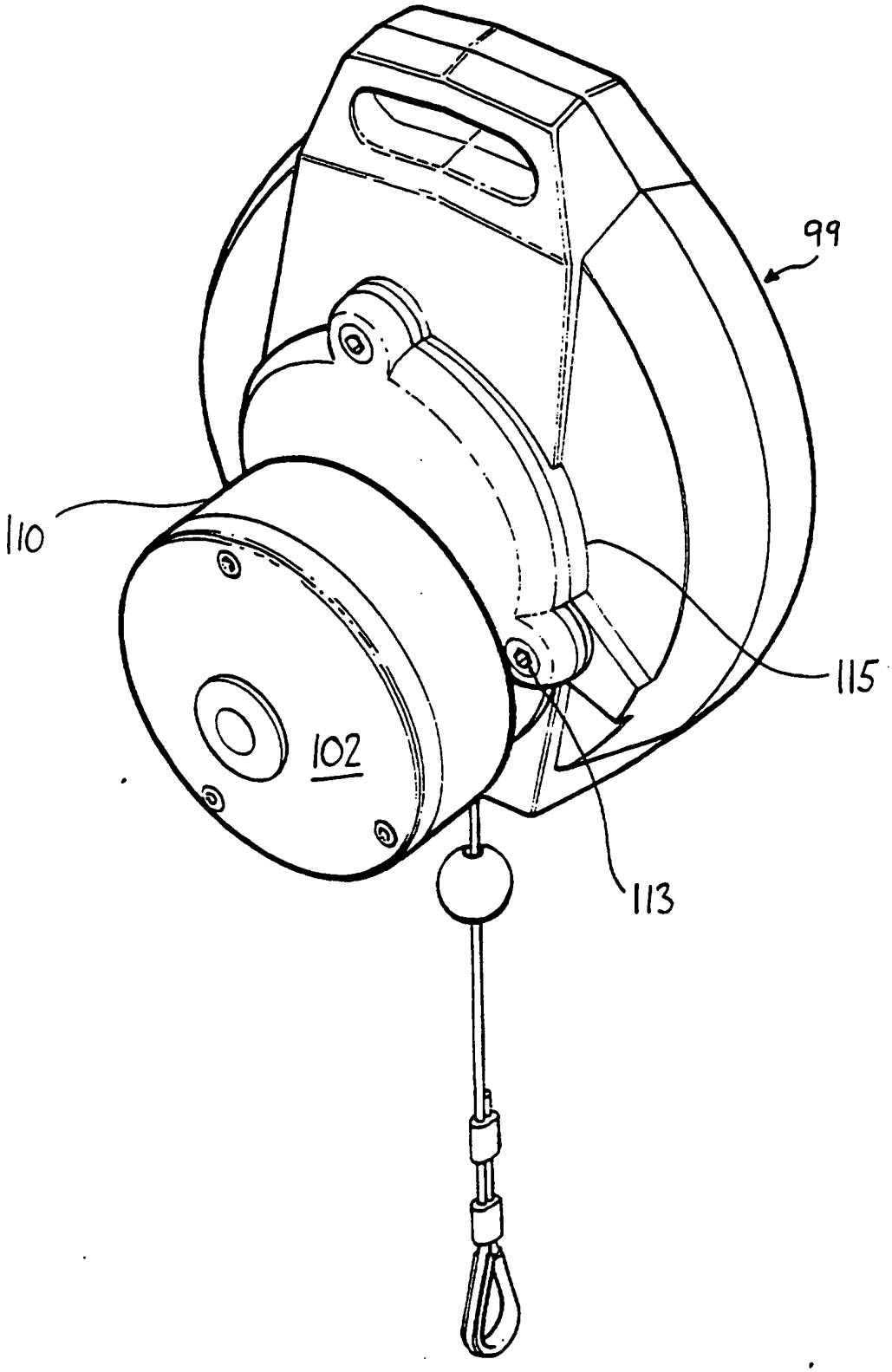


FIG. 4

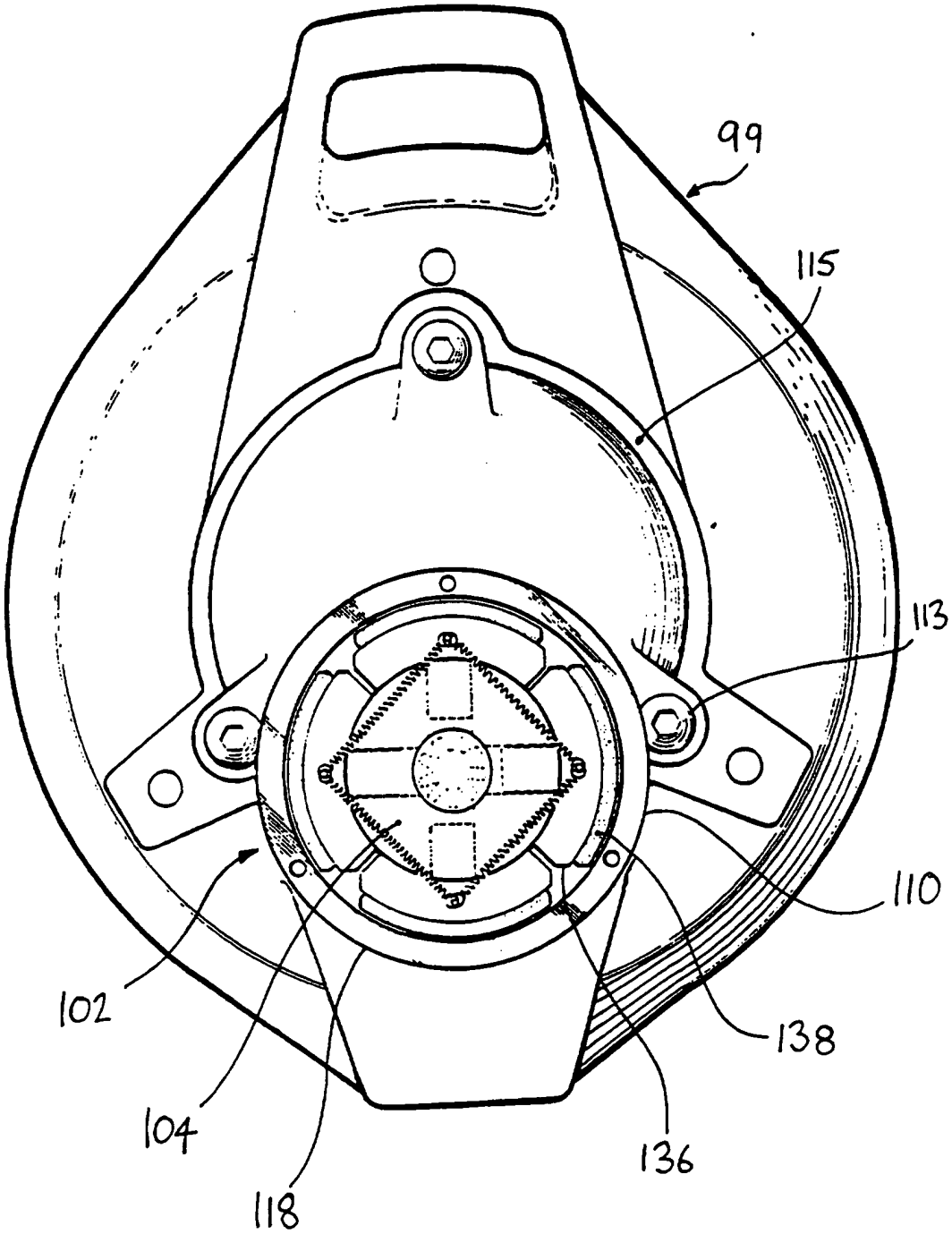


FIG. 5a

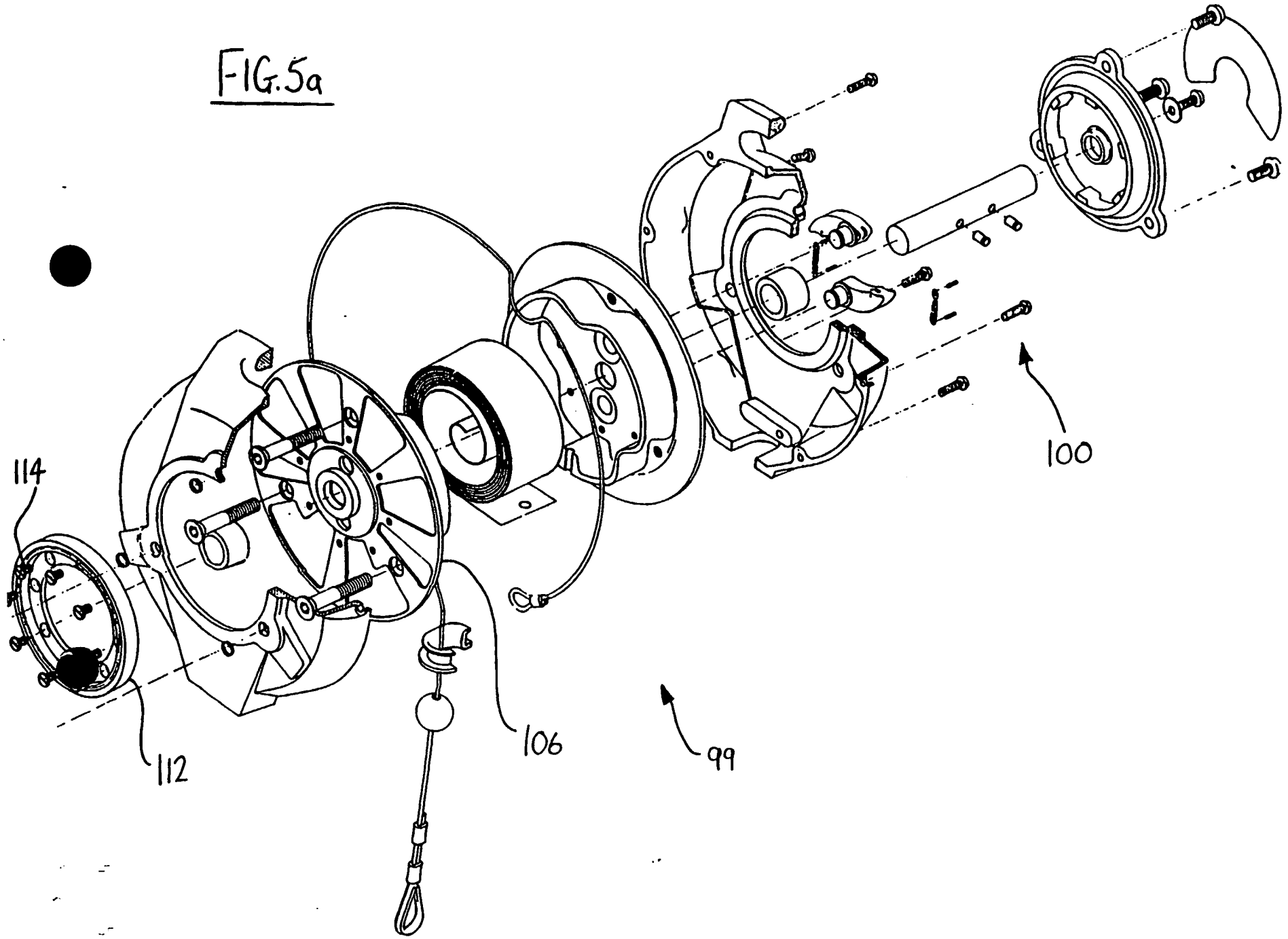


FIG. 5b

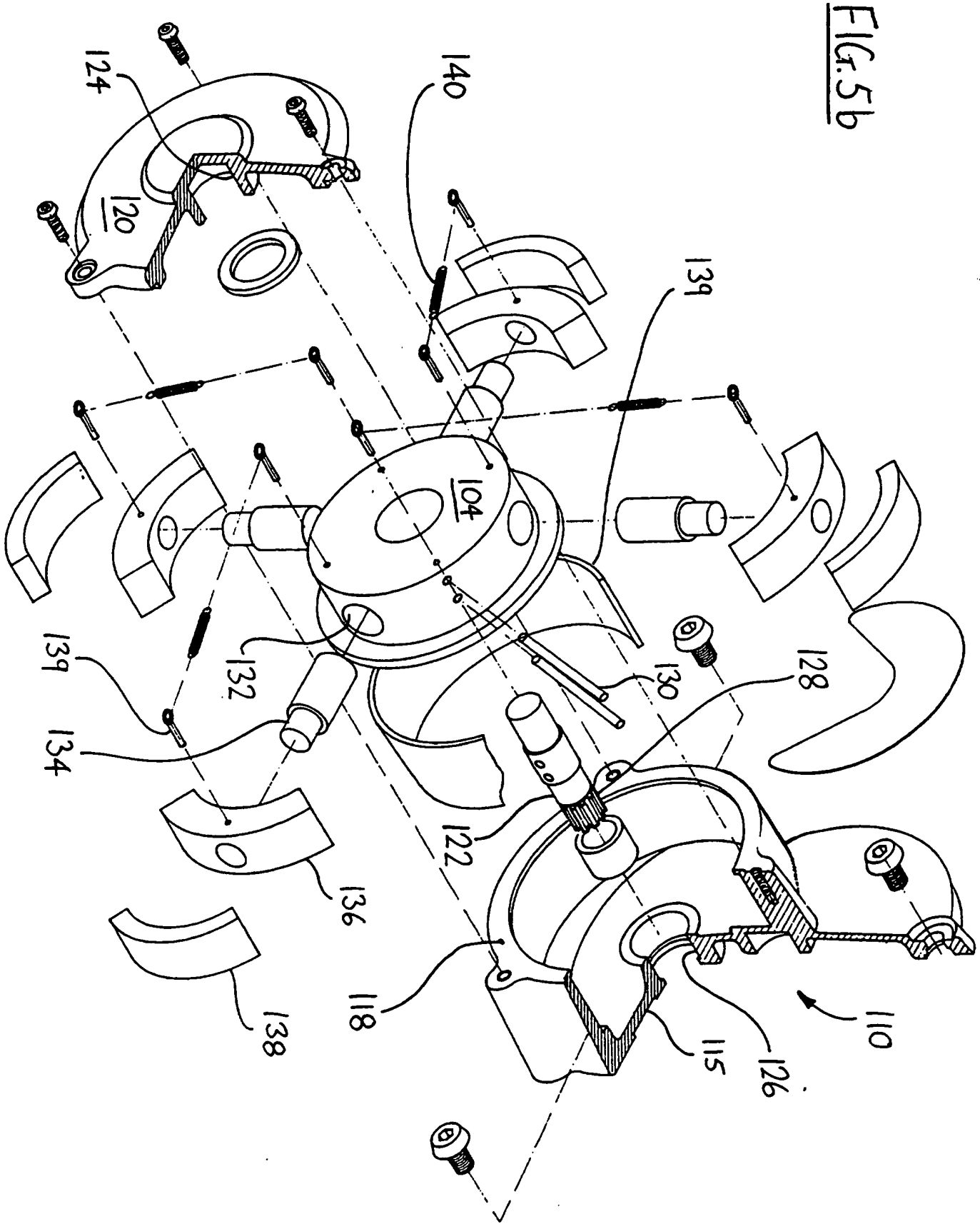

124
120
140
139
104
139
132
134
136
138
122
130
128
118
115
126
110

FIG. 6

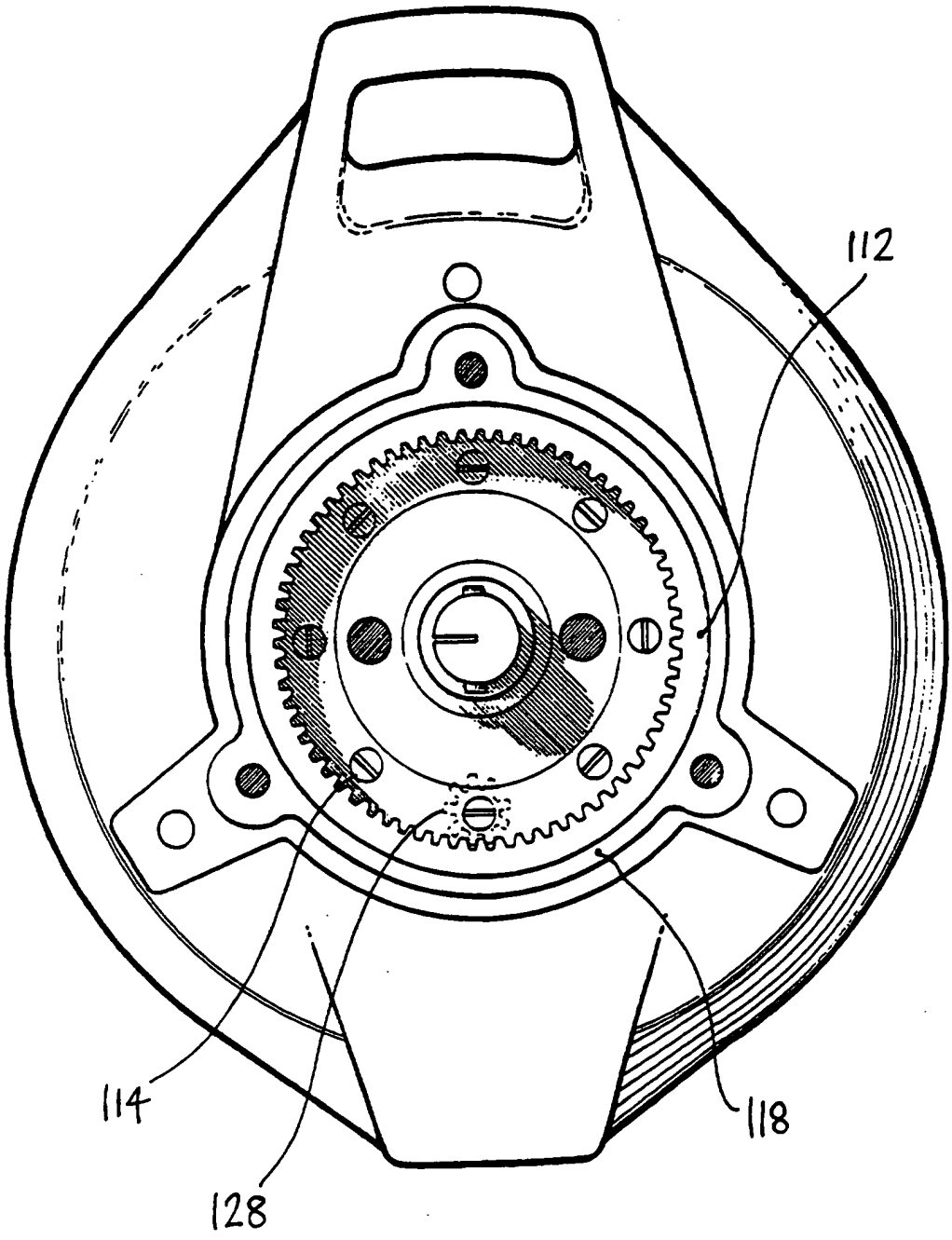
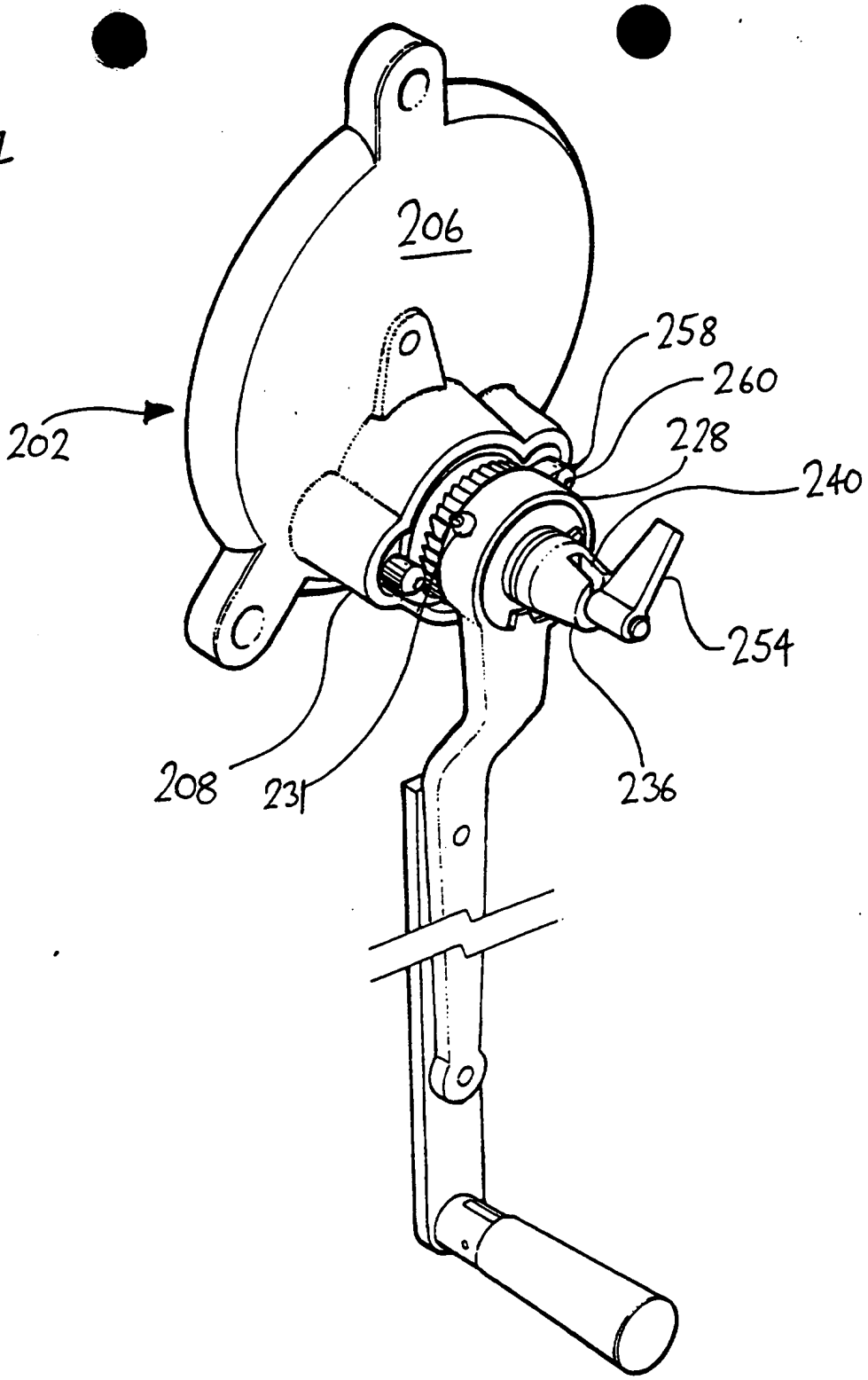


FIG. 7



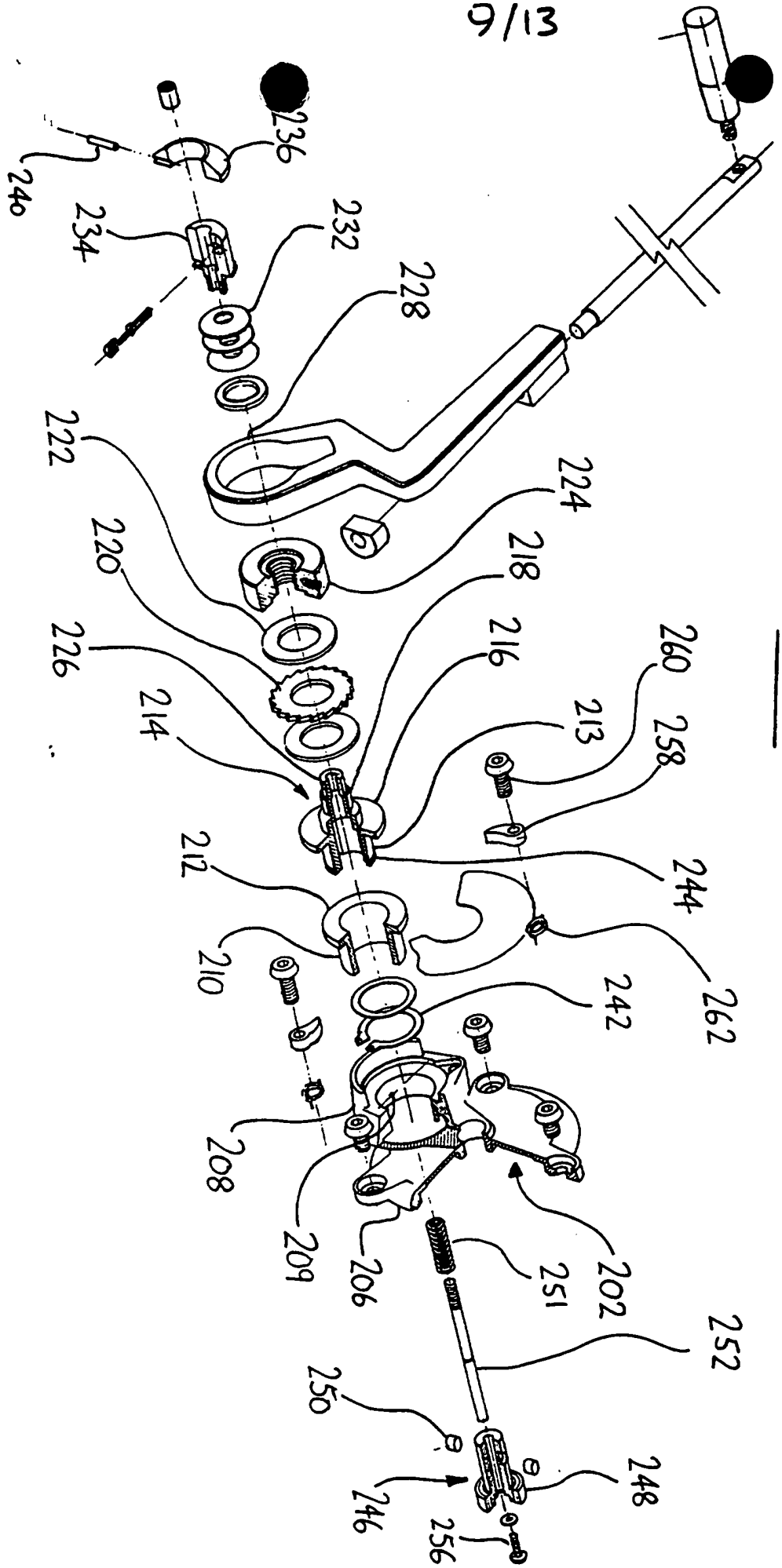

236
240
234
232
228
222
224
220
218
226
216
214
213
260
258
212
244
210
242
262
208
209
206
251
202
252
250
248
246
256

FIG. 8

FIG. 9

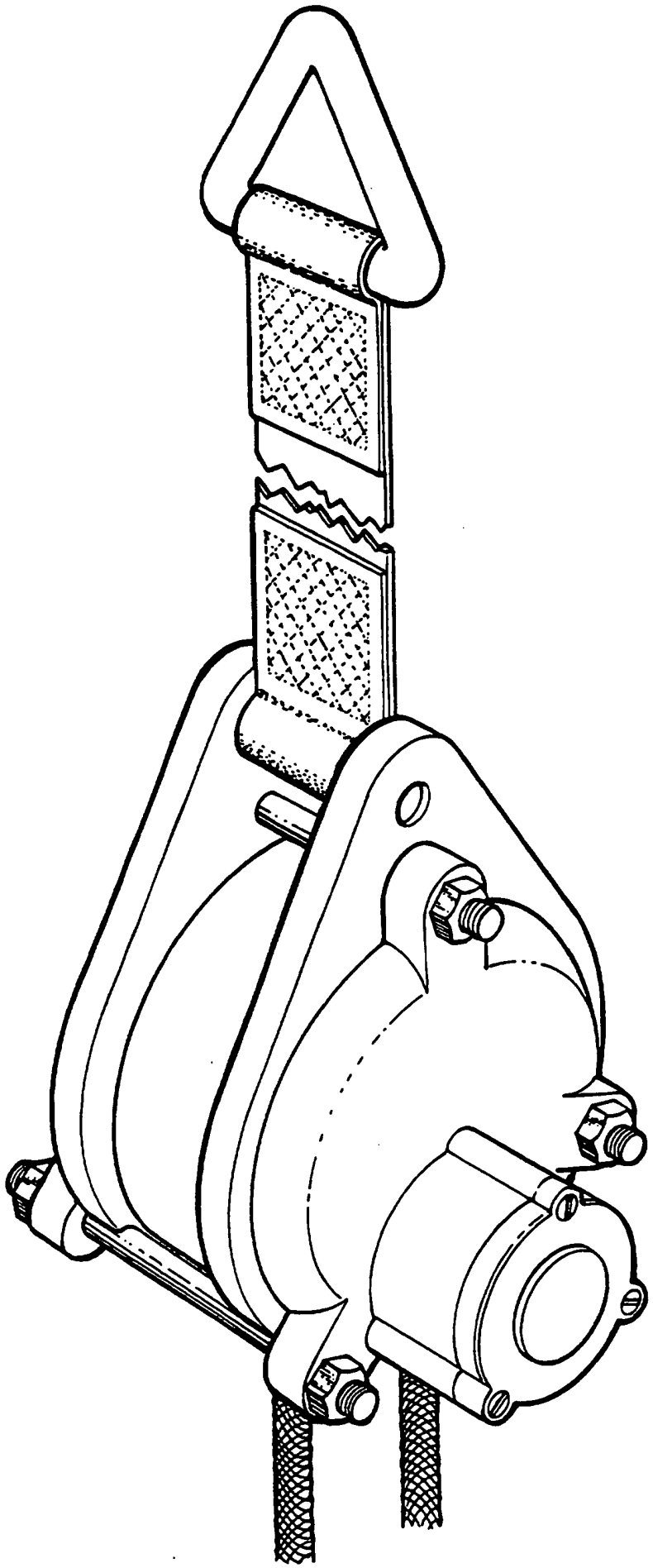
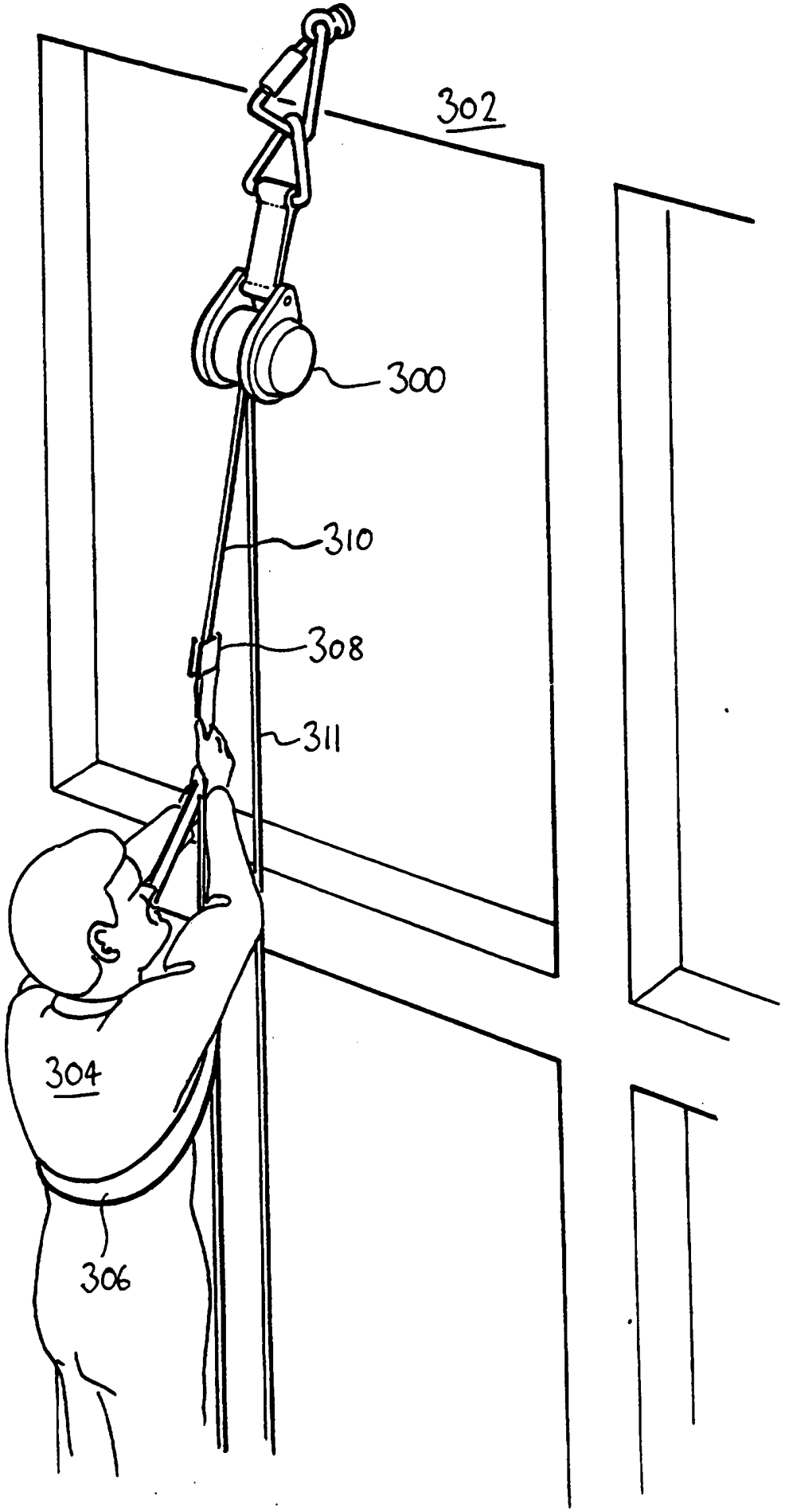


FIG. 10



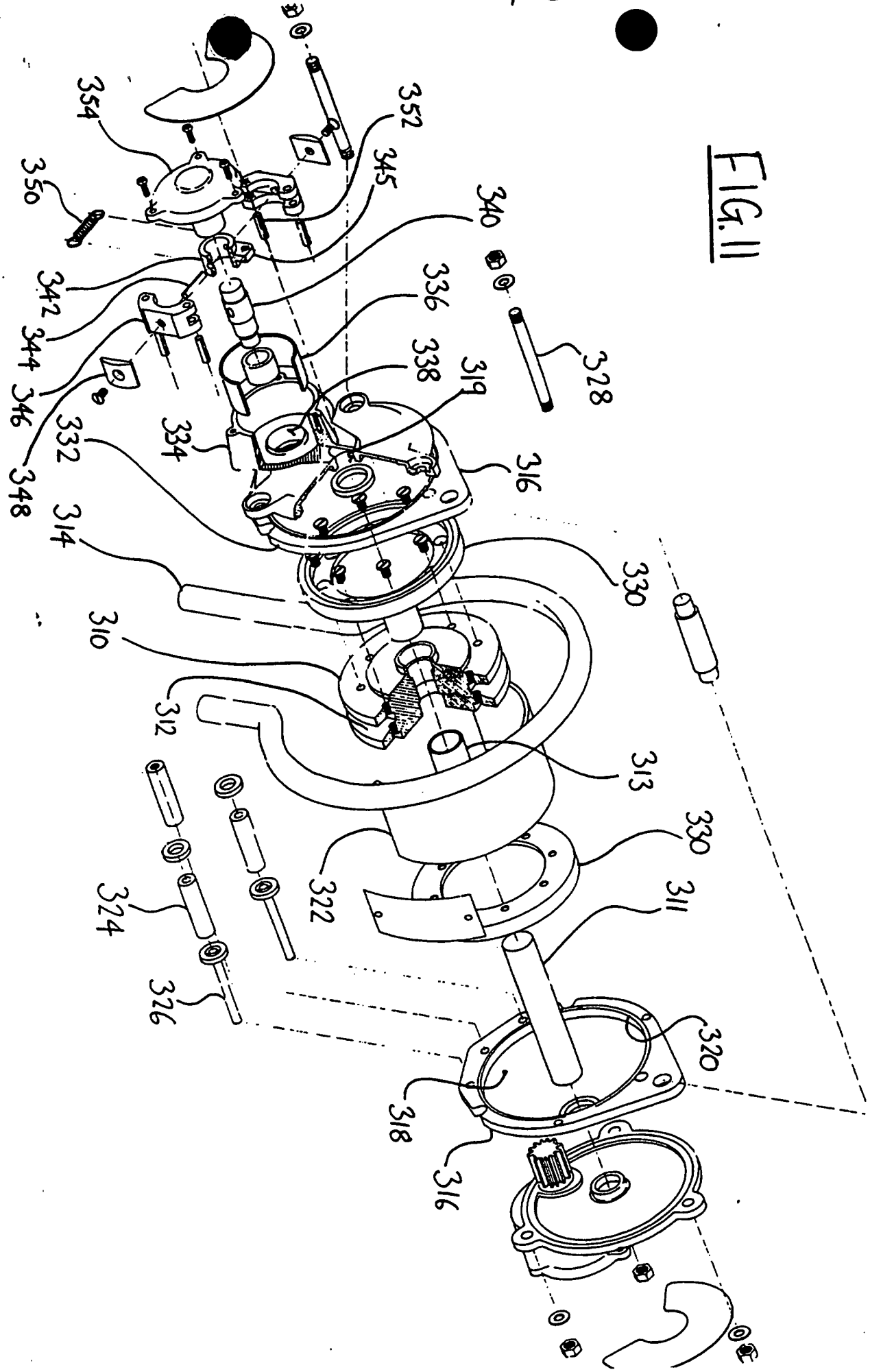

354
352
350
345
340
342
336
344
338
319
328
346
332
334
316
348
314
330
310
312
313
330
322
311
324
320
326
318
316

FIG. 11

FIG. 13

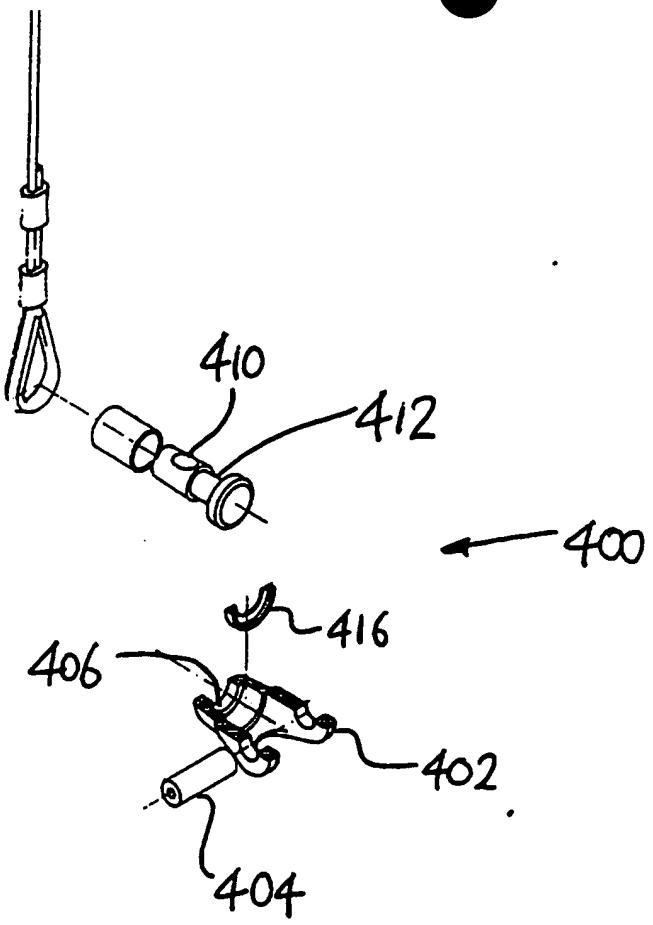
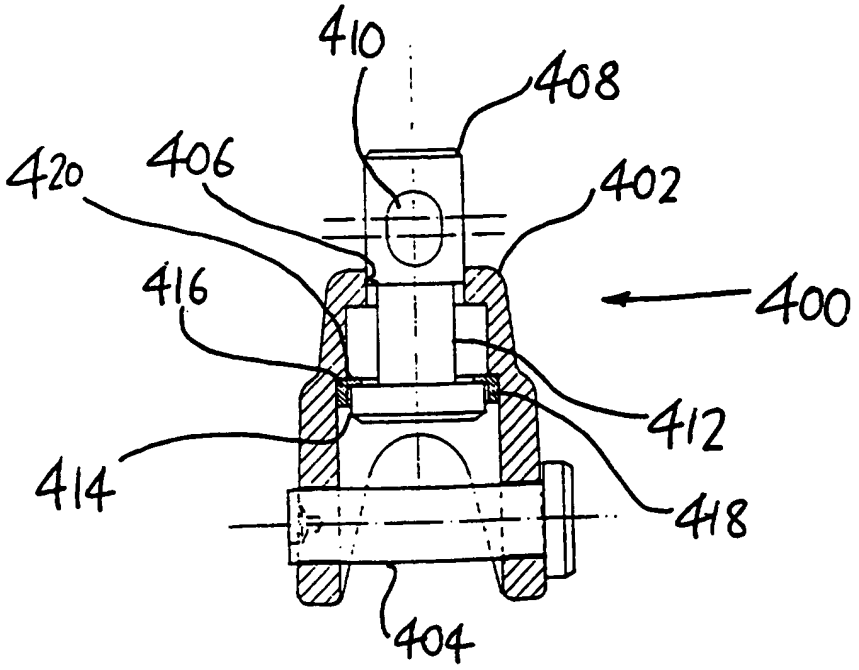

410
412
400
416
406
402
404

FIG. 12


410
408
420
406
402
416
400
412
414
418
404

DESCRIPTION

SAFETY DEVICE

The present invention relates to safety devices which, by controlling the rate at which a lifeline (or similar) is payed out, slow, stop or otherwise control, the motion of a falling user. Such devices may be used by persons working high above the ground, eg construction workers.

It is known to provide a safety device in the form of a fall arrester comprising:

a housing provided with means for secure attachment to some tether point;

a pulley contained within the housing and around which a length of rope or wire is coiled, the pulley being spring biased to take up slack in the rope, which is led out through a hole in the housing; and

a motion activated brake, such as a centrifugal brake, contained within the housing and acting on the pulley.

In use, the housing of such a device may be attached to some point on, eg, a scaffolding structure, while the free end of the rope is led to a harness worn by a person.

In normal use the brake is not activated and the user is free to move about, rope being payed out from

the pulley or taken in as appropriate to maintain a degree of tension.

Should the user fall, however, the rate at which the rope is payed out will rapidly exceed a predetermined maximum, whereupon the brake is automatically engaged to arrest the pulley and, consequently, the fall of the user, as to allow the controlled descent of the user at a slow speed.

In this way, persons working above the ground can be effectively protected from injury by falling.

There are, however, a number of shortcomings from which simple fall arresters of this known type suffer.

In simple devices, the pulley is arrested instantaneously upon braking, imposing large and potentially damaging loads on the rope, the brake and on the device as a whole.

Further, it may be inappropriate to simply stop all motion of the pulley and so suspend the user after falling, particularly if he/she has no way to climb down to the ground or back up to the starting point.

Known devices lack flexibility in their mode of operation. For example, simple known devices offer no way to raise the user back to his/her original height after a fall, or to lower him/her safely to the ground.

Simple devices of the above described type

include only one brake, failure of which could be highly dangerous.

The above, and other problems associated with known fall arresters can be overcome by means of the present invention.

In accordance with a first aspect of the invention there is provided a safety device for prevention of injury of a user by falling, in the form of a modular system comprising a main assembly module to which can be attached in use any two control modules, selected from a plurality of control modules each of which contains a different internal control mechanism, the main assembly module comprising a main housing, a pulley disposed rotatably within the main housing, and a lifeline wound onto or passed around the pulley, the main housing comprising means for secure attachment to a structure, an exit opening through which the lifeline is led out of the housing, two access apertures for providing access to respective axial ends of the pulley, and means enabling attachment of said selected two control modules over said two access apertures respectively, said two axial ends of the pulley being adapted to be coupled with the respective internal mechanisms of the attached control modules.

Preferably, the pulley is journalled on a shaft

which traverses the main housing and is located, in the assembled safety device, in respective bores in the control modules.

In a particularly preferred embodiment of the present invention, the shaft is prevented from rotating relative to the main housing, and the pulley contains a spiral wound spring, attached to the shaft, by which it is urged to rotate.

Preferably, one of the control modules of the modular system in accordance with the present invention is an arrester adapted to arrest the pulley if its rotational speed exceeds a predetermined maximum.

Preferably, the arrester control module comprises teeth which, in the assembled safety device, project through one of the control apertures, the pulley being provided with at least one radially inwardly biased locking dog which, in use, is moved radially outward to engage with the teeth when the pulley speed exceeds the predetermined maximum.

Still more preferably, the locking dog is formed as an elongate member pivotedly mounted, adjacent one of its ends, on an axially outer face of the pulley.

In a particularly preferred embodiment, the teeth are provided on a toothed ring which is frictionally restrained against rotation so that upon engagement of

the dogs some rotation of the toothed ring, and so of the pulley, is briefly permitted.

In a particularly preferred embodiment of the present invention, the modular system comprises a gear, the pulley and the gear being adapted to permit mounting of the gear on an axially outer face of the pulley, and control modules are provided which comprise a pinion for engagement with the gear.

Preferably, the modular system comprises a control module having a centrifugal brake driven by the pinion to slow, but not stop, the descent of a falling user.

Preferably, the modular system comprises a winch module having a drive pinion which is axially movable into or out of engagement with the gear.

In a preferred embodiment, the pulley is provided with a circumferential slot around which the lifeline is led, the form of the slot being such that tension in the lifeline causes the lifeline to lock in the slot rather than to move thereover, and both ends of the lifeline are led out through the exit aperture.

In accordance with a second aspect of the present invention, there is provided a descent control device, comprising a housing, a pulley disposed within the housing having a circumferential slot, a lifeline passed around the pulley and disposed in the slot, and

control means acting on the pulley, the form of the slot being such that the lifeline is prevented from motion thereover under tension, both ends of the lifeline being led out of the housing through an exit aperture, and the control means being adapted to slow but not stop rotation of the pulley to slow the descent of a person suspended from the lifeline.

Preferably, the control means comprise a centrifugal brake.

In accordance with a third aspect of the present invention, there is provided a connector adapted to link a lifeline to a harness, the connector comprising a pin and a body which are provided with respective means for connection to a lifeline or harness, the pin being telescopically received in a bore in the body and having an enlarged head, disposed within the body and too large to be drawn outward through the bore, and an indicator portion, the pin being normally retained in an inner position, in which the indicator portion is hidden within the body, by engagement of the enlarged head with a restraint which is located within the body and is frangible or deformable so that, in use, tension in the lifeline above a predetermined maximum breaks or deforms the restraint and causes the pin to be drawn to an outer position, in which the indicator portion lies outside the body

to provide a visible warning.

Preferably, the restraint is annular, comprising a ring defining an aperture through which a portion of the pin passes and an inwardly directed, deformable, rim which normally engages with the enlarged head.

Specific embodiments of the present invention will now be described, by way of example only, with reference to the accompanying Figures, in which:-

Fig. 1 is a partly sectional plan view of a first embodiment of the present invention;

Fig. 2 is an exploded illustration of the embodiment shown in Fig. 1;

Fig. 3 is a perspective view of a second, related, embodiment of the present invention, including a descent control module;

Fig. 4 is a plan view of the Fig. 3 embodiment, a cover having been removed to reveal certain working parts of the descent control module;

Fig. 5a and 5b are exploded illustrations of the Fig. 3 embodiment, Fig. 5a showing a housing assembly and Fig. 5b showing the descent control module used therewith to an enlarged scale.

Fig. 6 is a plan view of the housing assembly forming part of the embodiment shown in Fig. 3, the descent control module being omitted to reveal a ring gear;

Fig. 7 is a perspective view of a winch module in accordance with the present invention;

Fig. 8 is an exploded view of the winch module shown in Fig. 7;

Fig. 9 is a perspective view of an evacuation unit in accordance with the present invention;

Fig. 10 shows the evacuation unit in use;

Fig. 11 is an exploded illustration of the evacuation unit;

Fig. 12 is a cross sectional view of a hook/indicator according to the present invention; and

Fig. 13 is an exploded illustration of hook/indicator of Fig. 2.

A first specific embodiment of the present invention is illustrated in Figs. 1 and 2.

Briefly, a housing 28, 30 contains a pulley 4, 6 which is journalled on a shaft 18 and is urged to rotate by a torsion spring 16 to take up slack in a wire 2 wound around the pulley. In the present embodiment, two centrifugally actuated brakes are provided (one on either side of the pulley) both comprising two pivoted dogs 52 which are inwardly spring biased but which, when thrown outwards by centrifugal forces, engage with corresponding inwardly directed teeth 64 (seen in cross section in Fig. 1) to arrest the pulley.

The first embodiment will now be described in more detail.

The suspensory wire 2 (which could alternatively be rope or webbing) used as the lifeline is wound around a pulley (or drum) consisting of two pulley halves 4, 6 secured together by three bolts 8. A loop 10 at one end of the wire 2 is, when the device is assembled, disposed around one of the bolts 8 to secure the wire to the pulley.

Each pulley half 4, 6 comprises a disc portion 12, and from mutually opposing faces of the respective disc portions project respective ring-shaped walls 14 which are in mutual abutment when the pulley is assembled. An approximately cylindrical space is thus defined within the pulley, and this contains a spiral wound torsion spring 16, one end of which is secured to the (fixed) shaft 18 on which the pulley is journalled and the other end of which is secured to the pulley by means of a pin 22. The pin passes through a hole 24 adjacent the outer end of the torsion spring and is received and retained in a hole defined by respective, opposing slots 26 of semicircular cross section in thickened portions of the walls 14.

The torsion spring 16 tends to rotate the pulley, so that in use the wire 2 is wound onto the pulley

until there is sufficient tension in the wire to resist the effect of the spring. It is thereby ensured that slack in the wire is taken up.

The housing containing the pulley is itself formed of two cast, approximately cup shaped halves 28, 30 whose approximately circular rims 32 abut when assembled. Bolts passing through holes 36 in reinforced portions of the said rims 32 are used to fasten the two halves of the housing together. The housing thus formed comprises a handle portion 37 by means of which it can be securely anchored.

Both of the two halves of the housing are penetrated by respective, large diameter, circular axial holes 38. According to the present embodiment, these holes are normally closed by respective, approximately circular, covers 40, 41 attached to the outer faces of the housing halves by screws 42.

The covers 40, 41 are themselves penetrated by axial bores 44 into which the shaft 18 projects, being thereby maintained in position. Rotation of the shaft 18 relative to the housing is prevented.

The pulley is prevented from moving along the shaft by collars 50 disposed on the shaft on either side of the pulley, and respective washers 51 are interposed between the collars 50 and the respective covers 40, 41 to reduce friction/wear.

The two centrifugally actuated brakes of the present embodiment of the invention are of two, slightly different, types, one being intended to act as the primary brake and the other to serve as a backup.

The simpler, back up, brake, shown in the foreground (on the left) in Fig. 2 comprises two crescent shaped dogs 52, each provided with a respective stud 54 adjacent one end (referred to below as the proximal end to distinguish from the other, distal, end). The studs 54 are received in respective holes 56 in a thickened central part of the disc portion of the pulley half 4, thereby pivotedly mounting the dogs 52 on the pulley.

The two dogs are inter-connected by two helical springs 58, each of which connects the distal end of one dog to the proximal end of the other. Small pins 60 fasten the springs to the dogs. The springs urge the dogs to pivot into the inner positions in which they are shown in the figures.

In use, small rotational velocities of the pulley do not cause radially outward motion of the dogs 52. However, if the rotation of the pulley exceeds a maximum level, determined (inter alia) by the stiffness of the springs 58, centrifugal forces overcome the springs 58 and cause the dogs to pivot

about the studs 54 so that their respective distal ends move radially outward.

It will be noted from Fig. 1 that the cover 40 comprises an annular collar 62 which projects slightly into the casing half 30, and this carries, at its inner face, inwardly directed teeth 64. The teeth 64 are shown in cross section in Fig. 1. When the distal ends of the dogs 52 move outward far enough to contact the teeth 64, they are instantly locked in position, preventing rotation of the pulley and so arresting the fall of the user.

This instantaneous locking of the pulley imposes undesirably large stresses on the device and the lifeline. It is therefore preferable to provide for more gradual deceleration, and the primary brake, shown in the background in Fig. 2 (to the right), is adapted to provide this. In place of the fixed inwardly directed teeth 64 formed on the cover 40 of the back-up brake, it has inwardly directed teeth 66 mounted on the inner face of a toothed ring 68 which is sandwiched between two friction rings 70. All three rings are compressed between an outer surface of the casing half 32 and an opposing face of the cover 41.

Frictional forces thus act against rotation of the toothed ring 68, but do not wholly prevent it.

The remaining components of the primary brake including dogs 72 and helical springs 74 are as described above with reference to the backup brake.

In operation, rotational velocity of the pulley above a predetermined maximum causes the dogs 72 to fly outward and to lock against the teeth 66 of the toothed ring as described above with reference to the backup brake. In the case of the primary brake, however, the pulley is not instantly arrested, since the toothed ring 68 is initially rotated, despite the frictional forces restraining it, causing the pulley to be brought rapidly, but not immediately, to a halt.

The stiffnesses of the respective biasing springs 58, 74 of the two brakes are chosen so that the primary brake is actuated at a lower rotational velocity than the backup brake. The backup brake is thus only used in the event of failure of the primary brake.

One of the most important advantages of the safety device, constructed in accordance with the invention is that other modules/components can be used as alternatives to one or both of the two brakes of Figs. 1 and 2 without significant alteration of the pulley/housing assembly. Access to the pulley is available through the large diameter holes 38, and braking, retarding or other devices can therefore be

attached to or engaged with the pulley without disassembly of the housing. A modular system is thereby made possible, a given safety device having any of a number of combinations of controlling modules.

The point is made by the second specific embodiment of the present invention, illustrated in Figs. 3, 4, 5 and 6. This comprises a housing/pulley assembly 99 as shown in Fig. 1, provided with a backup brake 100 as already described, the relevant components being shown to the right in Figure 5a. However, in place of the primary brake, this embodiment comprises a descent control module 102.

The descent control module is designed not to halt a user's fall entirely, but to allow him/her to descend to the ground at a safe, controlled speed. To this end, and as will be described in more detail below, it comprises a hub 104 driven via a gear chain by the pulley 106, and associated with arcuate brake shoes 136, 138 which (when the lifeline is rapidly withdrawn as in a fall) are thrown outward against an inner face of a module housing 110. The friction thereby generated slows the rotation of the pulley, providing a safe, controlled rate of descent.

To consider the present embodiment of the invention in more detail, it will be seen in Fig. 5a

and in Fig. 6 that an internally toothed ring gear 112 is attached to an axially outer face of the pulley 106 by means of screws 114. The descent control module housing 110, containing all of the working parts of the descent module, is attached to an outer face of the main housing 99, covering one of the large diameter holes therein, by means of screws 113 passing through a back plate 115 of the module housing 110 - see Figs. 3 and 4.

Projecting from the back plate 115 is an annular wall 118 defining an internal cylindrical cavity, and the cavity is enclosed by a cover 120 screwed to the wall 118.

A shaft 122 (see Fig. 5b) axially traverses the cylindrical cavity, being journalled in a first bearing 124 in the cover 120 and in a second bearing 126 in the back plate 115. These bearings comprise roller races (not shown) to reduce friction. A portion of the shaft projects beyond the back plate 115 toward the main housing, and bears a pinion 128 which meshes with the toothed ring gear 112, so that the pulley 106 drives the shaft 122, the relevant gear ratio being such that the shaft 122 rotates several times faster than the pulley.

The hub 104 is contained within the cylindrical cavity detained by the annular wall 118, being mounted

on the shaft 122 and locked thereon by means of two radial pins 130.

The hub 104 contains four radial bores 132 which are radially outwardly open and are symmetrically angularly spaced. Slidably received in each of the bores 132 is a respective stepped pin 134, and attached to the radially outer end of each pin is a respective arcuate brake shoe consisting of a metal inner portion 136 and an outer portion 138 of friction material. Attachment of the stepped pins to the brake shoes is achieved by insertion of a reduced diameter portion of the pin into a corresponding bore in the inner portion 136, followed by insertion of a transverse locking pin 139.

In use, the brake shoes 136, 138 act on an annular brake liner 139 which is disposed around the inner face of the wall 118.

The brake shoes are each pulled inward toward the hub 104 by respective helical springs 140, each of which is attached by means of pins to respective brake shoes - see Fig. 5b.

In the event of a fall, withdrawal of the lifeline causes rapid rotation of the hub 104, and consequently the brake shoes are thrown outward to press against the brake liner 139. Friction between the brake shoes and the liner limits the rate of

rotation of the pulley, and hence the user's rate of descent. A descent velocity of 2m/s is not untypical.

Should the descent module fail, the back up brake would operate to arrest the user's motion and prevent injury.

Still another motion controlling module for use with the above described pulley/housing assembly is illustrated in Figs. 7 and 8, and is used as a winch. In this case the safety device could comprise a primary brake of the type described with reference to Fig. 1 in combination with the winch, so that once the fall of a user has been arrested, he/she can be raised back to his/her starting point.

The winch drives the pulley via an internally toothed gear as described above with reference to the descent controller.

The winch module itself comprises a winch housing 202 having a back plate 206 by which the module is joined to the main housing by screws and, integrally formed therewith, an approximately annular wall 208 defining a bore 209 in which is received a plain, hollow bearing 210, having a retaining collar 212 which abuts against the periphery of the bore 209 to keep the hollow bearing in place.

A stepped, hollow shaft 214 runs in the hollow bearing 210 and itself comprises a collar 216 which

abuts against the collar 212 of the bearing to restrain axial motion of the shaft in an inward direction (that is, in the direction toward the pulley/housing assembly.

While an inner portion 213 (that is, a portion lying toward the main housing) of the hollow shaft 214 is received in the hollow bearing 210, an outer stepped portion 218, projecting outward of the collar 216, receives a ratchet wheel 220 sandwiched and, in the assembled device, compressed, between two washers 222. Outboard of the ratchet wheel/washers, the shaft 214 receives a circular hub 224, axially penetrated by a threaded bore by which it engages with a threaded, reduced diameter portion 226 of the shaft. An annular portion 228 of a lever/handle assembly 230 surrounds the hub 224, being mounted thereon by means of screws 231 (see Fig. 7).

Outboard of the hub 224, the shaft 214 receives three shaped washers 232 which are retained in place by a hollow, externally threaded bolt 234, which screws into the end of the hollow shaft 214.

A frusto-conical component 236, penetrated by an axial bore and having two cutaway portions 238 (only one of which is seen in Fig. 7, the other being occupied by a lever 254 to be described below) of different depths, is retained on the hollow bolt 234

by means of a radial pin 240.

The shaft is restrained against axial outward motion by a circlip 242 which (in the assembled device) lies inboard of the back plate 206 and is received in an annular recess 244 in the shaft 214.

Inserted into the inboard end of the hollow shaft 214 is a hollow sub-shaft 246, the inboard end of which is integrally formed with a pinion 248. Two cuboidal keys 250, received in respective recesses in the sub-shaft 246 and engaging with corresponding recesses in the walls of the bore in the hollow shaft 214, prevent relative rotation of the shaft and sub-shaft.

For reasons which will become clear shortly, the sub-shaft 246 is inwardly biased (ie biased toward the main housing) by a helical spring 251 within the shaft 214. However, the sub-shaft is retained in place axially against the force of the spring 251 by a rod 252 which extends all the way through the shaft 214 and the sub-shaft 246. The outboard end of the rod 252 is externally threaded to receive the lever 254 (see Fig. 7), which is located, in use, in one or other of the cutaway portions 238 in the frustro-conical component 236. The inboard end of the rod 252 is internally threaded for receiving a retaining screw 256.

In use, the lever/handle assembly 230 is used to rotate the shaft 214 and the sub-shaft 246, whose pinion 248 meshes, when the winch is in use, with the internally toothed gear 200 to drive the pulley and so cause the lifeline to be wound in.

Rotation of the shaft 214 in the reverse direction, which would cause the lifeline to be payed out, is prevented by two ratchet teeth 258 pivotedly mounted on bolts 260 threadedly received in the annular wall 208 of the winch housing and biased by helical torsion springs 262 toward the ratchet wheel 220, forming a ratchet.

In normal use, that is when no fall has occurred, it is necessary for the pulley to be able to rotate (as the user moves about, and the lifeline is correspondingly withdrawn or payed out) without rotation of the winch lever/handle assembly 230. To this end, the pinion 248 can be withdrawn from engagement with the internally toothed gear 200 by moving the lever 254 from the deeper of the two cutaway portions 238 to the shallower. So doing moves the rod 252 outward, and the sub-shaft 246 is correspondingly drawn, in an outward direction, further into the hollow shaft 214 against the force of the helical spring 251, moving its pinion out of engagement with the internally toothed

gear 200.

In other embodiments of the present invention, the form of the pulley/housing assembly may differ from that described above. As an example of this, Figs. 9, 10 and 11 show a further embodiment of a pulley/housing assembly and associated controlling modules in accordance with the present invention.

The safety device illustrated in Figs. 9, 10 and 11 is intended primarily as an evacuation device, and differs from the above described embodiments in that the lifeline is not coiled onto the pulley. Instead, it passes once around the pulley, being prevented from slipping thereover by retention in a shaped, circumferential slot. A very long lifeline can thus be used, both ends of which are accessible.

Fig. 10 illustrates how the evacuation device may be used. The device 300 itself is shown securely tethered at the outside of a burning building 302. A user 304 wears a harness 306 connected to a rope grab 308, and it is by means of the rope grab that the user is attached to and supported on a first part of the lifeline 310. Note that on the other side of the evacuation device, a second part of the lifeline 311 is also accessible.

The user is allowed (by the evacuation device) to descend at a controlled rate until the ground is

reached.

The next user to descend would then attach him/herself (by means of a rope grab) to the second part 311 of the lifeline and descend.

In this way, a "see-saw" motion of the lifeline is achieved, one part being raised as the other is lowered, so that any number of persons may be evacuated. Alternatively, a lifeline in the form of an endless loop could be used.

To describe the evacuation unit in more detail, reference will be made in particular to the exploded view, Fig. 11.

As shown, the unit comprises a pulley 310, formed in one piece, running on a shaft 311 via two sleeves 313 and having a shaped circumferential slot 312 to receive a lifeline 314. When weight is placed on the lifeline 314, it locks in the slot 312 and is thereby prevented from motion relative thereto.

The lifeline, in the present embodiment, is a thick nylon rope.

A main housing containing the pulley is formed by two approximately circular side plates 316, each penetrated by a large diameter round hole 318 surrounded by an annular recess 320, and a curved cover 322 sandwiched between the two side plates and located in the respective annular recesses 320. The

cover 322 is formed as a sector of a circle, but since the circle is incomplete, the cover is downwardly open, and the lifeline 314 enters and exits the housing through this opening. Where it does so, the lifeline 314 passes over one or other of a pair of rollers 324 mounted on respective shafts 326 which are received in holes in the side plates 316.

The side plates 316 are fastened together by means of nuts and three threaded rods 328, extending between the side plates and passing through respective holes therein at locations radially outboard of the cover 322.

Two internally toothed ring gears 330 (precisely as in previously described embodiments) are screwed to respective sides of the pulley 310, to engage with controlling devices.

One of the advantages made possible by the invention is that the motion controlling devices used with the previously described pulley/housing assembly can be used, without adaptation, with the evacuation device, if required.

However, the present embodiment of the invention is provided with a descent control module slightly different in design from previously described modules.

The present descent control module has a substantially round back plate 332 screwed to an outer

face of one of the side plates 316, covering the hole 318 therein. An axial bore 319 in the back plate 322 receives and supports the shaft 311.

Projecting from and integrally formed with the back plate 322 is a substantially annular wall 334, defining a cylindrical cavity which is lined by a brake liner 336. A bore 338, co-axial with the annular wall 334, extends through the back plate 322, and therein is journalled a shaft 340. A portion of the shaft 340 projecting beyond the back plate 322 toward the main housing is formed as a pinion, and meshes with the ring gear 330.

Within the cylindrical cavity defined by the annular wall 334, a hub 342 is mounted on the shaft, being locked in place thereon by means of a radial pin 344.

The hub 342 comprises an annular portion for engagement with the shaft which is integrally formed with two tabs 345. Pivotedly attached to said tabs 345 by means of respective pins are two arcuate brake shoes inners 346, both of which are provided with outers 348 of friction material.

The brakes shoes 346, 348 are urged outward into contact with the brake liner 336 by a helical spring 350 attached to both brake shoes by means of pins 352.

A substantially circular cover 354 abuts against

and is screwed to the annular wall 334, and has a cylindrical, axial recess (not shown in the Figures) to receive and support the shaft 340.

In use, friction between the brake shoes and the brake liners limits the rate of rotation of the pulley to provide a safe rate of descent.

It will be appreciated that the present invention makes possible a flexible, modular fall arrester and evacuation device wherein different functional modules can be combined in various permutations.

In this way, redundancy of modules can be introduced to guard against failure of individual modules, or different functions can be combined in a single unit.

When a fall arrester of the types described above with reference to Figs. 1 to 10 is used to stop a person falling, large stresses are imposed on its components. It is therefore desirable for the arrester to be serviced before further use.

To provide a visible warning that the unit has been used in this way and should be serviced, the modular system in accordance with the present invention further comprises an attachment formed as an indicator 400, illustrated in Figs. 12 and 13.

The attachment/indicator 400 is used to join the lifeline to a harness worn by the user, and comprises

a hollow body 402 of circular cross section traversed, adjacent its lower end, by a horizontal pin 404 to which a harness can be attached.

The upper end of the indicator body 402 is penetrated by a vertical bore 406, in which a stepped indicator pin 408 is received. An upper portion of the indicator pin 408 lying above the body 402 is, according to the present embodiment, coloured black, and comprises a hole 410 by which the pin can be attached to the lifeline, while a narrowed lower portion 412 of said pin, within the body 402, is coloured red. Below the red, lower portion 412, the pin broadens to form a retaining head 414.

Upward motion of the indicator pin 408 is normally prevented by an annular restraint 416, the wall of which is an upside down "L" shape. That is, the wall of the restraint comprises a circular band 418 with, at its upper edge, an inwardly projecting rim 420.

The restraint is located at a shoulder in the indicator body 402, and is proportioned so that the retaining head 414 can slide into the band 418 but cannot pass through the rim 420.

In a fall, a large force acts, tending to draw apart the indicator pin 408 and the indicator body 402. In this event, the rim 420 of the restraint

yields, allowing the retaining head 414 to pass therethrough and move upwards until it abuts against a shoulder 422 surrounding the lower end of the vertical bore 406.

This motion of the indicator pin reveals the red lower portion 412 thereof, providing a visible warning not to use the safety device. Since the indicator is attached to the harness, this warning is immediately visible to the user.

CLAIMS

1. A safety device for prevention of injury of a user by falling, in the form of a modular system comprising a main assembly module and a plurality of control modules each comprising respective control means, the main assembly module comprising a main housing, a pulley disposed rotatably within the main housing and having two axially outer faces, a lifeline passed around the pulley, means for secure attachment of the main housing to a structure, an exit opening in the main housing through which the lifeline is led out of the main housing, two access apertures in the main housing for providing access to said pulley, and means for attachment to the main housing of two of the control modules, the two axially outer faces of the pulley being provided with respective engagement means for engagement with the respective control means of the two control modules, so that motion of the pulley can be controlled by the control means.

2. A safety device as claimed in claim 1, wherein the pulley is journalled on a shaft which traverses the main housing and is located, in the assembled safety device, in respective bores in the control modules.

3. A safety device as claimed in claim 2,

wherein the shaft is prevented from rotating relative to the main housing, and the pulley contains a spiral wound spring, attached to the shaft, by which it is urged to rotate.

4. A safety device as claimed in any preceding claim, wherein one of the control modules is an arrester adapted to arrest the pulley if its rotational speed exceeds a predetermined maximum.

5. A safety device as claimed in claim 4, wherein the arrester control module comprises teeth which, in the assembled safety device, project through one of the control apertures, the pulley being provided with at least one radially inwardly biased locking dog which, in use, is moved radially outward to engage with the teeth when the pulley speed exceeds the predetermined maximum.

6. A safety device as claimed in claim 5, wherein the locking dog is formed as an elongate member pivotedly mounted, adjacent one of its ends, on an axially outer face of the pulley.

7. A safety device as claimed in claim 5 or claim 6, wherein the teeth are provided on a toothed ring which is frictionally restrained against rotation so that upon engagement of the dogs some rotation of the toothed ring, and so of the pulley, is briefly permitted.

8. A safety device as claimed in any preceding claim, wherein the modular system comprises a gear, the pulley and the gear being adapted to permit mounting of the gear on an axially outer face of the pulley, and control modules are provided which comprise a pinion for engagement with the gear.

9. A safety device as claimed in claim 8, wherein the modular system comprises a control module having a centrifugal brake driven by the pinion to slow, but not stop, the descent of a falling user.

10. A safety device as claimed in claim 8 or claim 9, wherein the modular system comprises a winch module having a drive pinion which is axially movable into or out of engagement with the gear.

11. A safety device as claimed in any preceding claim, wherein the pulley is provided with a circumferential slot around which the lifeline is led, the form of the slot being such that tension in the lifeline tends to cause the lifeline to lock in the slot rather than to move thereover, and both ends of the lifeline are led out through the exit aperture.

12. A connector adapted to link a lifeline to a harness, the connector comprising a pin and a body which are provided with respective means for connection to a lifeline or harness, the pin being telescopically received in a bore in the body and

having an enlarged head, disposed within the body and too large to be drawn outward through the bore, and an indicator portion, the pin being normally retained in an inner position, in which the indicator portion is hidden within the body, by engagement of the enlarged head with a restraint which is located within the body and is frangible or deformable so that, in use, tension in the lifeline above a predetermined maximum breaks or deforms the restraint and causes the pin to be drawn to an outer position, in which the indicator portion lies outside the body to provide a visible warning.

13. A connector as claimed in claim 12, wherein the restraint is annular, comprising a ring defining an aperture through which a portion of the pin passes and an inwardly directed, deformable, rim which normally engages with the enlarged head.

14. A safety device substantially as herein described with reference to, and as illustrated in, any of the accompanying drawings.

15. A connector substantially as herein described with reference to, and as illustrated in, accompanying Figs. 12 and 13.

Patent Office

32.

Application No: GB 9521094.4
Claims searched: 1 - 11

Examiner: Colin Thompson
Date of search: 20 December 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): A5A; F2X

Int Cl (Ed.6): A62B 1/06,1/08,1/14

Other: Online: WPI, EDOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2238720 A	(Ta-Tan Liou) Whole document relevant	1,2,4,8
X	GB 2057871 A	(Bloder) Whole document relevant	1,2
X	EP 0086279 A1	(Geurtsen) Whole document relevant	1,2
X	WO 94/03234 A1	(Porsche) Whole document relevant	1,4
X	US 5343976 A	(Ostrobrod) Whole document relevant	1,2,4
X	US 4493396 A	(Borgia) Whole document relevant	1,2,4,8,9

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☑ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.
As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.